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PSYCHE

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THE GENUS LASIOPOGON (DIPTERA, ASILIDÆ)[1]

By A. L. Melander.

State College, Pullman, Wash.

The genus *Lasiopogon* is represented in the western states by several common species, some of which are undescribed. As characters separating these species are not difficult to discern the following table is presented in order to bring to date our knowledge of the species of this genus. If male specimens are available identification is facilitated, since distinctive characters are offered by the genitalia.

The species of *Lasiopogon* and *Cyrtopogon* have the face strongly gibbose, thus forming a natural group in the Dasypogoninæ. At first sight they appear to intergrade, but the two genera are quite distinct in several characters. The species of *Lasiopogon* are browner in general color, and have the abdomen nearly parallel-sided. They possess a vertical row of setæ on the hypopleuræ, lack the short first segment of the arista, and have the anal cell closed just within the margin. *Cyrtopogon* presents a more tapering abdomen, usually more pilose, the hypopleuræ with patch of fine pile, the trichostichal hairs, in place of bristles, the basal joint of the arista usually distinct, and the anal cell usually narrowly open. The male genitalia are different in the two genera; in *Lasiopogon* the lateral valves are most prominent, the lower valves being undeveloped, the dorsal side is deeply emarginate and furnished with a distinctive fringe; in *Cyrtopogaon* the lower valves are usually large and there is no dorsal fringe of setæ.

The species of *Lasiopogon* known from North America are separable on the characters given in the following key. Most of the species appear to be western in their distribution. The structure of the hypopygium affords the most reliable distinctions for identifying the species, and fortunately can be easily discerned without relaxing.

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[1] Contribution from the Zoology Laboratory of the State College of Washington.

Key to the Neartic Species of Lasiopogon.

1. Bristles of body and legs wholly or in part whitish; mystax white; abdomen rather dull . . . . .2.
Bristles black (not including the long straggling white setiform hairs sometimes present on underside of femora) . . .5.
2. Legs entirely black, coated with gray pollen . . . . .3.
Front tibiæ with basal two-thirds and middle tibiæ with base yellowish; median and lateral stripes of thorax brownish median stripe very feebly divided by a paler line; abdomen dusted with blackish brown, hind margins gray. (Ariz.) . . . . *arizonensis* Schaeffer
3. Abodmen sericeous with short and long white pile; hypopygium with yellow fringe at base above; thorax bivittate on dorsocentral rows. (on sand, Pacific Coast) . . . . .4.
Abdomen less pilose, base of segments rufous; thorax with four nearly median brown vittæ. (Nebr.). *quadrivittata* Jones
4. Lateral valves of hypopygium emarginate at apex and with a rectangular corner at end of upper edge; bristles typically wholly whitish; scutellum lightly dusted with fulvous. (Cal.) . . . . *arenicola* O. S.
Valves with rounded apex and with a broadly obtuse upper corner; lateral bristles of thorax black; scutellum cinereous-dusted. (Wash.) . . . . *actius*, n. sp.
5. Mystax wholly or in large part white . . . . .6.
Mystax wholly black . . . . .9.
6. Tibiæ and tarsi and sometimes femora also, reddish brown; wings lightly infumated; abodmen shining black, only hind angles of segments pruinose. (on low damp ground, Mass., N. J.) *terricola* Johnson.
Legs wholly black in ground color; wings quite hyaline . .7.
7. Large robust species measuring 12 mm.; abdominal segments marked with two anterior semicircular blackish

spots, the gray of hind margins extending triangularly between them; heavily pollinose and quite pilose. (Wash.) *ripicola*, n. sp.

Small species of 7 to 9 mm.............................8.

8. Nearly bare species; abdominal segments with narrow white pruinose fascia along hind margin; thorax trivittate with brown. (Wash.).......*trivittatus*, n. sp.

A great deal of white pile on body; the paler hind portion of abdominal segments extending forward along the middle; thorax bivittate. (Cal.)..........*drabicola* Cole.

9. Tibiæ and tarsi reddish-brown; wings quite infumated; halteres with black spot on knob; abdomen dull, the posterior two-fifths of each segment with gray fascia. (mountain species, Wash.) ....*fumipennis*, n. sp.

Legs black in ground-color; wings nearly hyaline........10.

10. Thorax evittate; hypopygial valves polished; small species, 6 to 8 mm...11.

Thorax vittate...12.

11. Mesonotum uniformly brown pollinose; hypopygial valves twice as long as wide, with strong projection below near base, dorsal fringe black. (Wash.).....*delicatulus*, n. sp.

Mesonotum brownish gray pollinose; valves short, very convex, almost hemispherical, dorsal fringe reddish. (Mass. to Col.)........................*opaculus* Loew.

12. General color gray pollinose; hypopygial valves cinereous, about three times as long as wide, without basal prong or swelling. (on stones about streams, Or., Wash.) *cinereus* Cole

General color brownish pollinose; hypopygial valves polished, or of *tetragrammus* grayish-brown pruinose.........13.

13. Space between intermediate and lateral stripes of thorax polished black; ovipositor white pilose; about four conspicuous bristles across each abdominal segment. (Can., N. H.) ....*tetragrammus* Loew

Thorax without shining stripes; no transverse rows of bristles on abdominal segments. (western species)......14.

14. Hypopygium greatly enlarged, wider than abdomen, its valves nearly as broad as long, with basal swelling below; abdomen largely polished. . . . . .15.
Hypopygium not wider than abdomen, its valves about twice as long as wide, with strong tooth on inner edge toward base; abdomen dull. (Wash.) . *monticola*, n. sp.

15. Thorax narrowly vittate; anterior crossvein beyond middle of discal cell. (Cal., Or.). . . . . *bivittatus* Loew
A narrow median dark line extending down the center paler stripe between the broad principal vittæ; anterior crossvein before middle of discal cell. (Id., Wash.) *aldrichii*, n. sp.

Lasiopogon actius, sp. nov.

Male.—Length 7-9 mm. Front and upper occiput dusted with brownish, face with white, hairs of upper part of head and of antennæ whitish with yellowish tinge; style three-fifths as long as third antennal joint. Notum rather closely pollinose, changing in color according to incidence of light, dorsocentral vittæ distinct, dark brown, curved, the broad undivided middle stripe yellowish brown, sides fulvous brown, connecting with the dorsocentral vittæ behind the gray humeri; scutellum, postalar callosities and a vitta extending forward from each callosity cinereous; hairs and bristles of mesonotal disk and of scutellar margin yellowish, lateral bristles stout and black; pleuræ cinereous, the mesopleura brownish, hairs of meso-, sterno- and hypopleuræ pale. Abdomen quite dull, first segment gray, 2-7 segments marked with paired basal semicircular brown spots and apical gray band, vestiture abundant and whitish; hypopygium slightly wider than abdomen, dorsal piece centrally polished, not emarginate, fringe fulvous becoming almost golden laterally, valves lightly dusted and with abundant yellowish hair, curved, over twice as long as wide and parallel-sided as seen obliquely from above, their apex rounded and furnished with short blackish hairs, base below strongly widening and then narrowed at attachment; venter cinereous, the coating thinner posteriorly. Legs gray dusted, hairs and femoral bristles whitish, bristles of tibiæ black and whitish mixed, of tarsi black, claws reddish, tipped with black. Halteres with pale yellow knob, wings hyaline, veins blackish, crossvein a little before middle of discal cell.

Female.—Third antennal joint even shorter, the style two-thirds or three-fourths the length of the third joint; ovipositor shining black, the terminal rosette consisting of long black hooks.

Types.—Sixteen specimens, collected on the dry sands of the seabeach near Seaview and Nahcotta, Washington, May to July. (Melander). The species is closely related to *L. arenicola*, but that species has a less patterned thorax, subshining scutellum and abdomen, wholly pale bristles, yellow rosette on ovipositor and a different construction to the hypopygium. The lateral valves of *arenicola* are squared off at the end and even emarginate, the dorsal fringe is golden, and the dorsal piece is polished.

Lasiopogon aldrichii, sp. nov.

Male.—Length 8 mm. Entirely black, the halteres yellow, calypteres yellowish, front brownish-gray pollinose, the pollen of face slightly more yellowish, mystax black, hairs of face and lower occiput cinereous pollinose with long silky white pile; style thick, one-half as long as third joint of antenna. The usual pair of anteriorly diverging stripes of mesonotum distinct and blackish, the immediate brownish stripe medially bisected by a distinct blackish line, lateral stripes vaguely represented by darkenings above root of wings; bristles and sparse hairs black; scutellum dusted at base, its hairs and bristles black; pleuræ dull gray pollinose; the hypopleural fringe consisting of a single row of long black bristles. Major portion of abdomen polished black, the hind margins of the individual segments grayish-pollinose, lateral hairs whitish, becoming black on posterior segments; genitalia large, forming a club-like globular termination to the abdomen, hairs rather short and black, the lateral valves strongly convex, nearly quadrate, the apical edge crenulate-truncate, lower basal angle not toothed but with an umbo, dorsal incision deep and U-shaped, the marginal fringes black, the hairs obliquely crossed; venter uniformly dark grayish-pollinose, subshining, the short sparse hairs pale. Legs entirely black, the coxæ pollinose and concolorous with pleuræ, remainder of legs shining, very lightly dusted, the hairs and bristles black except the fine pile at base of femora beneath, pulvilli fuscous. Wings lightly infumated, veins black, anterior crossvein slightly before middle of discal cell.

Female.—Pile of lower occiput more sordid white; lateral whitish hairs of abdomen shorter and confined to basal segment, ovipositor highly polished, short-conical, the ventral keel brown.

Types.—Male and female, Moscow Mountains, Idaho, June 29, 1918 (Melander). Sixty paratypes from same locality (Melander) and from the Blue Mountains of southeastern Washington (Piper and Melander) and Nahcotta, Washington (Melander). The two specimens from Nahcotta, male and female are indistinguishable from the others, notwithstanding their totally different provenience. These specimens have been taken on almost every visit to Moscow Mountain. They occur along the trails and frequent rocks on the summit. It is a pleasure to dedicate this species in honor of Dr. J. M. Aldrich, and in memory of the many trips we have made together to this interesting collecting ground. The species is evidently very closely related to *L. bivittatus* Lw. but is constant in showing the bisected median stripe of the thorax.

Lasiopogon delicatulus, sp. nov.

Male.—Length 6 mm. Ground color entirely black, halteres yellow, the root of wing and the calypteres light brownish. Vertex dusted with dull yellowish-gray, face almost silvery, mystax and rather sparse facial hairs white, upper occiput brownish dusted, lower occiput becoming whitish, the lower hairs short silky and white, hairs and bristles of upper part of head short and black, style scarcely one-half the length of the broad third joint of antenna. Thorax brownish-pollinose, the dorsocentral stripes only vaguely indicated, middle stripe not divided, bristles black, scutellum completely dusted, bare except for the few marginal hairs; lower pleuræ becoming grayish-blue, hypopleural fringe consisting of about five black setæ. Abdomen slender, mostly shining, the hind margin of the segments narrowly whitish and with thinner cinereous pollen extending across the posterior two-fifths of each segment and also triangularly filling the extreme sides, first segment entirely cinereous pollinose, hairs very sparse, short and whitish; hypopygium of same diameter as abdomen, the lateral valves curved, two and one-half times as long as the width of the apical half, abruptly broader on basal half so as to form rectangular projection at middle beneath, apex of valves rounded, hairs rather sparse long and black, dorsal notch broad and deep, fringe of each side with black hairs; venter uniformly grayish dusted, its hairs fine, short, sparse and whitish. Legs entirely black, lightly dusted, the coxae cinereous, the hairs of femora and coxæ white, of tibiæ and tarsi black, bristles strong and black, pulvilli piceous. Wings hyaline, veins black, anterior crossvein a little before middle of discal cell.

Female.—Hairs of face in large part black, the polished ovipositor as long as sixth segment, blunt, ventral keel castaneous.

Types.—Mount Rainier, Washington. Six specimens from Alta Vista, Crystal Mountain, and Van Trump Park, July and August, 1922 (Melander).

The collection of these specimens was largely made possible through a grant from the Elizabeth Thompson Science Fund for a study of the alpine insect fauna of Mt. Rainier.

Lasiopogon fumipennis, sp. nov.

Female.—Length 8 mm. Black in ground-color, heavily dusted. Upper part of head brownish, hairs short, sparse, fine and black, face cinereous, pile long, abundant and black, pile of lower occiput fine dense and white; style one-third the length of the third joint of antenna. Mesonotum thickly brown-pollinose, dorsocentral vittæ widely separated, moderately narrow and brown, median stripe not divided; humeri and pleuræ cinereous, no pile, four black setæ in hypopleural row, no dorsocentral bristles, two prealar black bristles, anterior part of notum with scattered minute appressed black setulæ, no hairs; scutellum brownish gray pollinose, its sparse marginal hairs black. Posterior two-fifths of abdominal segments cinereous pollinose, anterior portion nearly black and subshining, first segment alone with outstanding hairs which on the hind margin are setiform and black and white mixed, remainder of abdomen with minute black setulæ; ovipositor polished black, nearly as long as sixth and seventh segments combined, the ventral keel castaneous. Legs black, very lightly dusted, the posterior tibiæ with brownish tinge, hairs of femora very short, sparse and whitish, of tibiæ black, bristles black, two preapical extensor bristles on front femur, one on anterior face of middle femur, an imperfect row along upper front face of hind femur, under side of femora with about three straggling long white setiform hairs. Pulvilli alutaceous; wings infumated, veins black, anterior crossvein at middle of discal cell; halteres yellow, the upper side of knob with distinct black center, calypteres yellow.

Types.—Paradise Park, Mount Rainier, Washington, Aug. 1921 (Melander). Two paratypes, same locality and south slope of Mount Adams, Washington. (Melander).

Lasiopogon monticola, sp. nov.

Male.—Length 9 mm. General color brownish-gray due to heavy coat of pollen, vertex and upper occiput dusted with brown, face cinereous brown, mystax entirely black, hairs of lower occiput fine silky and white, of upper occiput black; style two-fifths the length of third antennal joint, thorax marked only with the narrow dorsocentral brown stripes which diverge anteriorally, median space not bisected, bristles black, two lateral bristles in front of suture, about five on postalar callus, about five presutural dorsocentrals; scutellum margined with about eight black bristles in addition to interspaced black hairs, bare on disc; six bristles in hypopleural row, mostly black, four black hairs at posterior margin of mesopleura. Anterior half of abdominal segments piceous, posterior half cinereous brown, hairs white, becoming black at apex, five black bristles in lateral row of first segment; hypopygium globose black shining, somewhat wider than termination of abdomen, the dorsal incision very broad, its fringe black, lateral valves very broad, less than twice as long as wide, truncate at apex, the lower margin with very strong tooth, hairs coarse and black, venter concolorous with posterior portions of tergites, its hairs fine and whitish. Hairs of femora white in large part, the outer half of femora with about five extensor setæ, the upper front face of hind femora setose; tarsi concolorous with remainder of legs, claws piceous with black apex, pulvilli alutaceous. Halteres and calypteres yellowish; wings lightly cinereous, veins black, anterior crossvein slightly before middle of discal cell.

Female.—Ovipositor short, ventral keel black, hairs of abdomen short and mostly black.

Types.—Mount Adams, Washington, July 24, 1921 (Melander). Other localities, Moscow Mountain, Idaho, and Mount Rainier, Washington. Thirty specimens.

Lasiopogon ripicola, sp. nov.

Male.—Length 10 mm. Dull brownish-gray, heavily pollinose and rather densely pilose species, upper part of head alutaceous, with abundance of black hairs but no bristles, face whitish, the dense hairs nearly white with slightly yellowish tinge, with a few black hairs intermixed on upper portion, lower occiput heavily white pilose, antennal hairs black, third joint compressed cylindrical, slightly more than twice the length of the acuminate style. Dorsum of thorax brownish-gray, the dorsocentral vittæ widely separated, dark brown and rather narrow, bearing about six very fine black setæ of which three are presutural, humeri cinereous, lateral markings very indistinct, three prealar bristles; scutellum dark cinereous, the apical fine bristles black and hairs white; pleuræ cinereous with faint yellow tinge, mesopleura with black hairs behind, sternopleura with fine white hairs, hypopleural fringe consisting of a few white and black bristle-like hairs. Abdomen not shining, the segments dark brown with apical two-fifths cinereous, the brown color intensified as two semicircular spots, the gray color extending forward triangularly between the brown markings, pile conspicuous and whitish, long on sides of second and third segments, sides of first segment with a cluster of black bristles in addition to the pile; hypopygium larger than diameter of end of abdomen, black, subshining, mainly black-hairy, dorsal fringe transverse and black, declivous beneath fringe and not emarginate but with strong central broad projection, lateral valves spoon-shaped, the inferior margin entire, without tooth below but with slight basal umbo, venter uniformly gray pollinose and with an abundance of fine whitish hairs. Legs coated with gray pollen, front femora with two preapical extensor bristles, hind femora with a complete row of black bristles along upper anterior face, bristles of tibiæ and tarsi black, hairs of legs abundant, fine and white, pulvilli alutaceous. Wings hyaline, veins black, anterior crossvein at two-fifths the length of the discal cell, halteres yellow, the base brown, calypteres and fringe yellow.

Female.—Facial hairs more yellowish, ovipositor black polished, short, carina usually black.

Types.— Wawawai, Washington, May 20, 1911 (Melander) Eighteen paratypes from same locality and from Wilbur, and Yakima (Jenne) Wash. Most of the specimens were taken in the month of April.

Lasiopogon trivittatus, sp. nov.

Female.—Length 7 mm. Entirely black in ground color, the halteres and calypteres pale fuscous, the carina of the ovipositor castaneous, upper part of head yellowish-gray, bristles and hairs black, face whitish, its hairs nearly white with slightly yellowish tinge, lower pile of occiput fine and white. Thorax thickly coated with cinereous pollen, the dorsocentral stripes full brown, a median stripe of similar brown color and supraalar indications of lighter brown; bristles prominent and black, a strong presutural dorsocentral present, scattered black setulæ on anterior portion of mesonotum; scutellum densely cinereous, bare except for black marginal bristles and setula; pleuræ heavily coated with cinereous, almost pruinose, a slight tinge of yellowish developed beneath root of wing. Abdomen scarcely at all shining, first segment wholly cinereous, second to seventh segments fulvous over greater portion, the posterior margins narrowly cinereous, the gray color extending forward at the sides to merge into the fulvous, no long pile, hairs appressed, whitish, becoming black on posterior segments, ovipositor slightly longer than seventh segment, polished, blunt, but little tapering; venter heavily cinereous pollinose. Legs densely coated with gray pollen, femora with a few whitish long bristle-like hairs beneath, no coating of pile but the short hairs of femora and under side of tibiæ white, hairs of remainder of tibiæ and of tarsi and bristles black, pulvilli brownish. Wings nearly hyaline, veins blackish, anterior crossvein slightly before middle of discal cell.

Holotype.—Gold Creek, Montana, July 29, 1918 (Melander.)

OBSERVATIONS ON THE SO-CALLED TRUMPETER IN BUMBLEBEE COLONIES.[1]

By O. E. Plath,

College of Liberal Arts, Boston University.

About 250 years ago, the Dutch painter Goedart (1685) published a comprehensive treatise[2] on insects, volume 2 of which contains a unique and probably the oldest account of the life-history and habits of bumblebees. The account seems to be based almost entirely on the author's own observations, and is of interest chiefly because of its many naive anthropomorphisms. Thus, for example, Goedart (pp. 242-245) states that the members of a bumblebee colony, besides keeping a "king" like the honeybees, also have another individual among them which mounts to the top of the nest each morning about 7 A. M., and, like the bugler in the army, calls his companions to work by rapidly vibrating his wings, thereby producing a noise not unlike that of a drum. This performance, according to Goedart (p. 245), lasted for about a quarter of an hour each morning, and was observed repeatedly, not only by him, but also by others. About seventy-five years later, Goedart's (1685) observation was confirmed by the French Abbé Noël de Pluche (1764)[3], but de Pluche (p. 185) found that the "drummer", or "trumpeter", which he had under observation, called his companions to work at 7.30 A. M., instead of 7.

No one seems to have questioned this fantastic story until 1742 (about 75 years after the story originated), when the great French engineer and entomologist, Réaumur (pp. 1-30), published his observations on bumblebees. Although this famous scientist had a large number of bumblebee colonies under observation, he was unable to discover any such behavior as that described

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 225.

[2] The first edition of this work appeared from 1662-1669, both in Dutch and in Latin. It was later also translated into English (1682) and French (1700).

[3] According to Sladen (1912, p. 48), other editions of this work appeared as early as 1732. Translations into English (by Samuel Humphreys (1740), German (1746), and Spanish (1754), made this comprehensive work accessible to a large number of readers outside of France.

by the earlier observers, and therefore came to the conclusion that Goedart's (1685) "trumpeter" story was a fable. Réaumur's (p. 30) opinion in this matter naturally carried much weight, being accepted by such eminent entomologists as Kirby and Spence (1818, p. 384), and dealt the bumblebee "trumpeter" a blow which was effective for almost 150 years, when Goedart's (1685) story was again revived by the well-known Austrian bumblebee student Hoffer (1881, 1882-83).

Being acquainted with the contradictory claims of Goedart (1685) and Réaumur (1742), Hoffer (1882-83, p. 23) tried for a number of years to find a "trumpeter" among the numerous bumblebee colonies which he had under observation, but his efforts were unsuccessful until the summer of 1881. On July 7 of that year, Hoffer (p. 23) obtained a strong colony of *Bremus* (*Bombus*) *ruderatus* which he placed in a window facing southeast. Early the following morning, Hoffer's (p. 24) attention was suddenly attracted by a peculiar humming in the new colony, and, upon investigating, he found that the sound was produced by one of the larger bees which was perched on the waxen envelope of the nest and was vigorously, but uniformly vibrating her wings. Overjoyed at having rediscovered the long-sought "trumpeter," Hoffer (p. 25) roused his wife and children, and later also called in the neighbors, to witness the interesting performance. However, Hoffer's (1882-83) "trumpeter", or "trumpeterette" as she ought to be called, evidently was somewhat of a slave-driver, and rather persistent, as compared with those of Goedart (1685) and de Pluche (1764), for "with painful regularity" she called her companions to work every morning shortly after three o'clock, and continued her "trumpeting" for about an hour. Hoffer (p. 25) now became interested to know what would happen if he removed the "trumpeter" from the colony, and, on doing so, found that thereafter the "trumpeting" was performed by another member of the colony, although about an hour later than before. As the colony grew smaller toward the end of the summer, the activities of the "trumpeter" became more and more irregular. This, and the fact that one of his former students claimed to have heard a "trumpeter" in a colony of *Bremus lapidarius*, led Hoffer (1882-83, pp. 25, 26) to the conclusion that only *Bremus ruderatus*, and perhaps some other "hypogeic" species, have "trumpeters," but only while the colonies are strong.

Hoffer's (1882-83) confirmation again brought Goedart's (1685) "trumpeter" story into good repute among biologists for a period of more than twenty years. With apparently the single exception of Pérez (1889), it was accepted—in most cases after personal verification—by Firtsch (cf. Hoffer, 1882-83, p. 25), Kristof (1883), Härter (1890), Sharp (1899), Marshall (1902), and Bengtsson (1903). Pérez (p. 117), while not in the least doubting the general correctness of Hoffer's (1882-83) observations, rejected the latter's interpretation by pointing out (1) that there is little sense in having a "trumpeter" unless he be the first one to rise, and (2) that the sound produced by the "trumpeter" is of no use whatever, as far as rousing the colony is concerned, since (according to Pérez) bumblebees, like honeybees and ants, are completely deaf. Pèrez (1889) then offers his own explanation. After expressing the opinion that the bumblebee "trumpeter" fulfills no social function, and that the "trumpeting" is probably done for his own benefit, Pérez (p. 117) suggests that the "trumpeters" in bumblebee colonies, like the so-called ventilators among honeybees, are newly-hatched individuals which are training their wing muscles for the long flights which they will soon make. However, as we have already seen, Pérez' (1889) theory, although more plausible than that of Goedart (1685), seems to have made little or no impression upon contemporary biologists.

Fourteen years after the publication of this theory, a third interpretation was offered by the well-known German bee student von Buttel-Reepen (1903, 1907). Unlike Pérez (1889), this author suggested that the bumblebee "trumpeter" has the same social function as the ventilators in the honeybee colony,[4] namely, to reduce the temperature, or to expel moisture or bad odors from the nest. Similar conclusions were reached by the Norwegian biologist Lie-Pettersen (1906). This new interpretation was accepted—in some cases after extensive experimentation—by Stierlin (1906), Wagner (1907), Gundermann (1908), Lindhard (1912), and Sladen (1912).

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[4] Since writing the above, I have discovered that a similar explanation was offered by Mr. J. Angus in a letter to Messrs. A. S. Packard and F. W. Putnam (cf. Packard (1868), 35 years before von Buttel-Reepen published his interpretation. Mr. Angus' letter partly reads as follows: "I have found the males [of *Bremus* (*Bombus*) *vagans*] plentiful near our garden fence, with a hole such as would be made by a mouse. They seem to be quite numerous. I was attracted to it by the noise they were making in fanning at the opening. I counted at one time as many as seven thus employed, and the sound could be heard several yards off. Several males were at rest, but mostly on the wing, when they would make a dash among the fanners, and all would scatter and sport around. The workers seem to be of a uniform size, and fully as large as the males. I think the object of the fanning was to introduce air into the nest, as is done by the Honey-bees."

However, within the last decade, Goedart's (1685) "trumpeter" story has found another adherent in Bachmann (1915, 1916). What is more, Bachman (1915) has discovered that the bumblebee "trumpeter", in addition to rousing the members of the colony in the morning, also attends to the "curfew" in the evening. This latter perfomance, Bachmann (1915, p. 87) describes as follows: "Um ½ 9 Uhr begann der Hummeltrompeter sein Abendlied. Es war ein längerer Ton, unterbrochen von einem Triller ähnlich wie wenn ein Tier im Kästchen fliegen würde. Der Trompeter schlug aber nur, auf der Wabe stehend, die Flügel."

The activity of the bumblebee "trumpeter" in the morning is described very vividly by Bachmann (1916, p. 103) in the following words: "Genau um 6 Uhr erhebt sich ein Summen im Nest, das ununterbrochen 2 Minuten dauert. Ich musste gleich an den Hummeltrompeter denken, den Hoffer in einem Nest von *Bombus ruderatus* entdeckt hat. Dreimal setzt mein Musikant an, bis es lebendig wird und ein Tierchen zum Abflug erscheint. Um 6.26 bringt ein geschäftiges Weibchen eine grosse Larve geschleppt und der Trompeter übt unentwegt seine Kunst. Zuerst in gleicher Tonlage summend, werden, wenn es länger dauert, die Schwebungen höher und tiefer, vibrierend, dann stossweise wie das Geräusch des Wagnerschen Hammers oder bei der Entladung elektrischer Funken, endlich wie ein langsamer Trommelwirbel, bis der Ton etwas höher wird und dann langsam erstirbt.

"Mitunter höre ich deutlich die Flügel schlagen und meine dabei, es fliege eine Hummel nahe am Kopf vorüber. Dieses Wecken dauert von 6.44 bis 7.06, also 22 Minuten ohne Unterbrechung and ohne die geringste Störung meinerseits. Bis ½ 8 Uhr höre ich noch dreimal einen kürzeren Ruf. Dann kriechen gleich 3 Hummeln auf einmal aus dem Nestloch, nachdem mit Körbchen beladene im Tor vorher einpassiert waren und der Betrieb in der Hummelburg kommt in regen Gang."

These two passages would not have been written, had Bachmann (1915, 1916) paid more attention to the literature of the preceding decade. As we have already seen, Bachmann's (1915, 1916) assertions were contradicted years before, by statements published by several authors, notably von Buttel-Reepen (1903), Lie-Pettersen (1906), Wagner (1907), Lindhard (1912), and Sladen (1912). To these may be added certain observations and experiments of my own.

During the summers of 1921 and 1922, I had under observation about sixty Bremus (Bombus) colonies belonging to ten[5] of our thirteen New England species, and have frequently had occasion to observe the behavior which gave rise to the "trumpeter" story. That the fanning of these so-called trumpeters has to do with ventilation of the nest, and not with rousing the colony, or the exercising of wing muscles, may be demonstrated very easily by exposing a bumblebee colony to the rays of the sun, a fact which was first pointed out by Lie-Pettersen (1906) and Wagner (1907). The conclusions which these two authors reached are corroborated by the following observations which were made during the summer of 1921.

Of the thirteen colonies which I had under observation during that summer, eleven were kept in windows facing south and the remaining two in a window which faced north. Like Lie-Pettersen (p. 18), I found that on every warm day, especially if the weather was sultry, one or more workers in each of the colonies on the south side of the building mounted to the top of the nest and began to fan shortly after the rays of the sun reached the nest-boxes. In a colony of *Bremus impatiens*, consisting of about 125 individuals, the number of fanning workers sometimes even increased to more than a dozen. As soon as the sun receded from their nest-box, these "trumpeters" discontinued their work, one after another, and crawled back into the nest.

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[5] *Bremus affinis, bimaculatus, fervidus, impatiens, pennsylvanicus, perplexus, separatus, ternarius, terricola*, and *vagans*.

While this restless activity was in progress on the south side of the building, not a single bee, as a rule, was engaged in "trumpeting" in the two colonies which were kept on the north side, although one of the latter -also belonging to *Bremus impatiens*—consisted of more than 450 workers. The exposure to the hot midday sun evidently did not agree with the bees, for the colonies on the south side of the building did not thrive nearly so well as those on the north side, and during the following summer all of my bumblebee colonies were therefore kept in shady situations.

While "trumpeting" in a bumblebee colony is most pronounced when the nest is exposed to the rays of the sun on a hot day, it may, as is indicated by the observations of Goedart (1685), de Pluche (1764), Hoffer (1882-83), Bengtsson (1903), and Bachmann (1915, 1916), also take place in the morning and evening, in fact, as Wagner (1907) has pointed out, at any time of the day. Thus, for example, I have occasionally found one or two workers fanning at various hours during the night, even if the temperature outside was less than 70°. In this case, as has been suggested by von Buttel-Reepen (1903), fanning no doubt has to do with the expulsion of moisture or disagreeable odors from the nest.

Neither is it true, as Hoffer (1882-83), von Buttel-Reepen (1903), and Sladen (1912) assume, that "trumpeting" is resorted to only by species which have subterranean nests. Wagner (1907) found that *Bremus muscorum*, a European species which usually nests on the surface of the ground, resorts to fanning when the temperature of the nest gets too high, and this, as will be seen later, is also true of *Bremus fervidus* in this country.

As already stated, Hoffer (1882-83) believed that small Bremus colonies have no "trumpeter." Wagner (1907) and Lindhard (1912), on the other hand, claim that small colonies also resort to fanning. In order to determine which one of these claims is correct, the following experiment was performed. At 2 P. M., on June 3, 1922, I exposed the next-box of a small colony (1 queen and 2 workers) of *Bremus impatiens* to the rays of the sun. Three minutes later, one of the workers crawled to the top of the nest and began to fan, and within another minute, the remaining worker and the queen appeared and assisted in this activity.

Later in the summer, an experiment was also carried out to test Pérez' (1889) theory, according to which the so-called bumblebee trumpeters are newly emerged individuals which are exercising their wing muscles. On August 14th, at 1.30 P. M., I removed the board which shaded the nest of a queenless colony of *Bremus fervidus* so that the nest-box was exposed to the sun. The result was as follows: At 1.34, a worker appeared on top of the nest, and after crawling about a few seconds, began to fan vigorously. By 1.36 two more workers were engaged in this work, and by 1.38, the number of "trumpeters" had increased to six. All of these "trumpeters", as the hardened pollen lump on the thorax showed[6], were old bees which had done considerable foraging. *Bremus fervidus* usually nests on the surface of the ground, and hence this experiment incidentally also shows that Hoffer (1882-83), von Buttel-Reepen (1903), and Sladen (1912) are wrong in assuming that only "subterranean" species have "trumpeters."

Summary and Conclusions.

1. The so-called trumpeters in bumblebee colonies are bees which are engaged in ventilating the nest.
2. This ventilation is brought about by a rapid vibration of the wings and may take place at any time during the day or night.
3. Species which nest on the surface of the ground likewise make use of this method of ventilating their nests.
4. Ventilation by fanning is also resorted to by small bumblebee colonies.
5. Pérez' theory, according to which the so-called trumpeters in bumblebee colonies are newly emerged individuals which are exercising their wing muscles, is not founded upon facts.

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[6] The source of these pollen lumps will be discussed in connection with another paper.

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A NOTE ON A RECENTLY INTRODUCED LEAFHOPPER.

By Geo. W. Barber,

Bureau of Entomology, U. S. Dept. of Agriculture.

On July 21, 1919 the writer took a single specimen of *Allygus mixtus* Fabr. on the trunk of a beech tree at Medford, Mass. This specimen was determined by Messrs. Sanders and DeLong and a note of its occurence published by them (8). The species was also noticed in a local list published by the writer (9).

During the season of 1920 over forty specimens of the insect were taken from the same tree, the occurence ranging from July 16 to September 3. No specimens other than these were seen. Hundreds of specimens were taken from this tree during 1921, and a few near by and in adjoining towns from the middle of July to the middle of September.

So far as these collecting records go it would seem that this insect was rapidly gaining a foothold in this locality, at least one thriving colony having become well established. However, during 1922 only two specimens were captured and but one of these on the tree mentioned heretofore.

This species is not uncommon in Europe and northern Africa where it occurs quite generally as the following distribution record by Oshanin (6) will show; Sweden, Germany, England France, Spain, Italy, Austria, Hungary, Roumania, Algeria, Tunis, Finland, and Russia. Specimens from Germany are in the writer's collections. It is a common species in England according to Buckton (4), and Edwards (5) records that it feeds on the oak. So far, the writer has not taken the insect from oak in Massachusetts but the young have not been observed.

Allygus mixtus was originally described by Fabricius (1) in the genus *Cicada*. Subsequent writers placed the species in the genera *Jassus* and *Thamnotettix* until Scott (3) described the genus *Allygus*. This name had been proposed by Fieber (2) but it seems that he had given no description of it.

Three species assigned to *Allygus* now occur in the fauna of the United States;

Allygus gutturosus (Ball) (7) originally described as *Thamnotettix* from California.

Allygus modestus Fieb an European species discovered in New Jersey by Mr. H. B. Weiss and recorded by Sanders and DeLong (8).

Allygus mixtus Fabr.

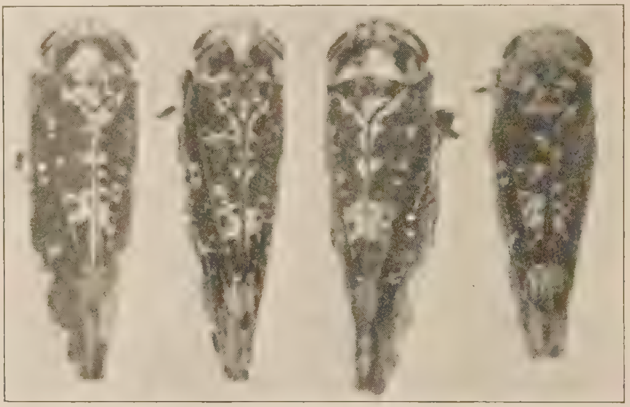

Fig. 1. *Allygus mixtus* Fab., Adults.

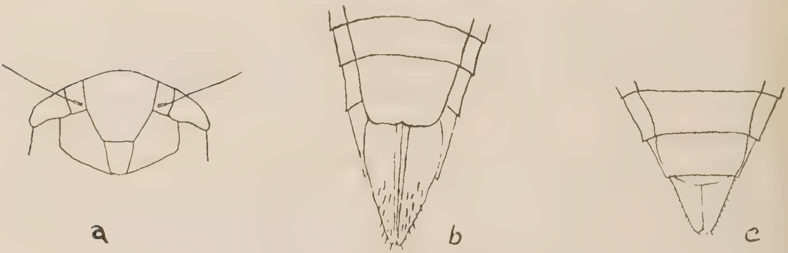

Fig. 2. *Allygus mixtus* Fabr., a-face; b-female genitalia; c-male genitalia.

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FLOWER VISITS OF INSECTS

By Charles Robertson

Carlinville, Illinois.

In the study of the pollination of flowers by insects (6) a good many observations have been made which relate primarily to the habits of insects and only indirectly, if at all, to the elucidation of insect flowers. It is proposed here to consider the data from the standpoint of the insects.

The flower groups adopted are divided into a social set, whose flowers are in heads, spikes or close umbels, so that insects pass from one to another without taking wing or climbing, and a non-social set. The latter contains 54.4 per cent of the flowers, and is divided into Ma, long-tongued bee flowers, including 11 adapted to birds, hawk-moths and butterflies, and Mi, short-tongued bee flowers, including six fly flowers. The social set includes Mas, long-tongued bee flowers; Mis, short-tongued bee flowers; and Pol, visited by miscellaneous short-tongued insects.

The insect visits were first distributed under Müller's flower classes. These were then divided into non-social and social sets and the visits were distributed again under them. Of 9 cases, maxima under Hb fell under non-social Hb in 6. In 27 other cases, however, maxima under B, AB, or A always fell under the social sets.

The percentages for each class and color and the visits observed are:

	Non-social		Social			Total	Colors		
	Ma	Mi	Mas	Mis	Pol		Red	White	Yellow
Local Flora	28.3	27.9	16.4	22.0	5.1	540	29.2	39.6	31.1
Flowers observed	30.2	24.2	18.7	21.5	5.2	437	30.2	39.1	30.6
Before July	28.9	32.3	11.0	22.9	4.6	235	26.3	44.6	28.9
After June	30.5	15.2	28.2	19.0	6.8	262	34.3	33.5	32.0
Pollinating visits	7.5	13.3	20.4	39.8	18.7	13971	16.8	51.3	31.7
Non-pollinating visits	41.1	9.5	31.3	10.9	7.0	852	46.3	33.3	20.3

Percentages of visits to red flowers are given for the Berlin Garden and Low Germany (Loew **2**,**3**) and the Alps (Müller **5**,512-23). The percentages of red flowers observed are for the Alps 41.6 and Berlin Garden 48.2. In 31 cases, all except Sphingidæ, the percentage of local visits to red ranges from 5.4 to 51.3 less, or an average of 24. The term *preference*, as used here, means only that the percentage of visits is greater than the percentage of flowers observed. For each group the percentages of flowers visited as well as the visits were distributed under each flower class. Usually these are much alike, so that the percentages of flowers visited are not mentioned except when they are quite different from the visits.

The flowers were also divided into an early group containing 235 plants, 142 blooming, and 33 observed, before July, and a late group containing 262 plants, 144 blooming, and 58 observed, after June. In the case of 60 plants the visits observed before July and after June were referred to each group. Of these 60 plants 13 are not native. Visits to these groups were first distributed under Müller's classes. Before July there are maxima under B, AB, including Po, and A. After June there is a slight increase in Hb, including O and F, and a marked increase in B′.

The visits to these groups were also distributed under the new classes. The early group shows maxima of the simplest flowers, non-social Mi, and white colors. These along with Mis decrease in the late group, which shows maxima of Ma and red, and a great increase in Mas. The specialization of the late group is marked by the increase of the social flowers from 38.7 to 54.1 per cent.

When B′ as an element of the flora changes from 8.0 to 28.2 per cent, the maxima of the insect groups change from the four other dominant classes to B′. The only exceptions are the ruby-throated and the Non-aculeata. The maxima of the same insects, when distributed into early and late sets of the new categories, in 62.8 per cent of the cases, fall under the same flower groups.

The Bombidæ, Euceridæ, Anthophoroidea, Dasygastræ and long-tongued bees in general change from Ma to Mas, due to the fact that Mas is not well represented in the early flora.

Apis mellifera, the Ceratinidæ and Bombyliidæ change from Mis to Mas. Early there is greater contrast between Ma and Mis than late between Mas and Mis. Consequently these mid-tongued insects are excluded from a considerable number of early Ma, while they can reach the nectar of most of the late Mas. A like change in Melectoidea and Andrenidæ is owing to the fact that the late ones have longer tongues.

BEES.

Apis mellifera.—Of 196 visits, 30.1 per cent are to Mis, 27.0 to Mas, 43.3 to white, 65.3 to social flowers and 28.3 to Compositæ. Of its pollen visits 36.7 per cent, while of its nectar visits 29.0, are under yellow. Red shows: local 24.4, Low Germany 47.3, Berlin Garden 55.0 and the Alps 60.7. Before July the hive-bee prefers Mis; after June, Mas, Mis and Pol. The maxima shift from AB 33.3 to B′ 44.7, Mis 32.2 to Mas 43.8.

An introduced domesticated insect, it is the most important single obstacle in the way of the anthecologist. It occupies an intermediate position between long-tongued and short-tongued bees, though it makes more visits to flowers preferred by the latter. On account of its abundance and long flight it makes more legitimate visits than any other insect, except *Bombus americanorum*.

It shows inferiority to several indigenous bees, *Bombus*, *Melissodes*, *Megachile*, *Calliopsis andreniformis*, in its inability to utilize some complicated flowers like *Desmodium*, but this is somewhat offset by its ingenuity in extracting pollen from *Dicentra cucullaria*.

Bombinæ.—Of 717 visits to 273 flowers, 39.4 per cent are to Ma, 31.9 to Mas, 41.1 to red, 10.0 to Labiatæ, 10.6 to Leguminosæ and 25.2 to Compositæ. Visits to red are: Low Germany 61.5, Berlin Garden 63.7 and Alps 64.7. Four prefer Ma, four Mas, seven red and one yellow.

Loew (**2**, 87) states that since male bumblebees have shorter tongues than the workers, the relations holding for the females and workers do not apply to them, and that therefore they prefer flowers of class B′. This is not dependent upon the difference in the length of the proboscis, but is largely a phenological matter connected with the late flight of the workers, after May 13, still later flight of the males, after July 4, and the late blooming of B′ which is really a phenological class. The males only resemble bees in general in preferring B′ in their late visits. The percentage of visits to B′ after June is for the females 32.1, workers 38.1, and males 57.6. So that under the same conditions all three forms prefer B′. The females show a maximum under Ma, 47.3, while the workers and males show maxima under Mas, 43.5 and 57.8.

Seven species, forming 4 per cent of the long-tongued bees, make 23 per cent of the long-tongued bee visits, the average being 102. *Bombus americanorum* makes 227 visits, the highest number for any visitor. Bumblebees are the characteristic visitors of long-tongued bee flowers and have probably had more influence in producing such flowers than all other bees together. They make 39 per cent of the visits to Ma, the highest specialized of non-social flowers.

Psithyrus.—Of 47 visits to 39 flowers, 61.7 per cent are to Mas, 87.2 to social flowers, 42.5 to Compositæ, 14.9 to Labiatæ and 12.7 to Leguminosæ.

Loew (2, 103) says: "the habit possessed by female bumblebees of chiefly seeking out hymenopterid flowers, while the males give preference to social flowers, is exaggerated in the parasitic genus *Psithyrus*, which constitutes a small side-branch of the group. The species of this genus consequently prefer dark-colored flowers even more than do the short-tongued species of *Bombus*."

The European visits for the females show 34.3 more in percentage of visits to Hb than to B′, while the local visits show only 6.0 more. In the local species the apparent preference for red flowers is not a consequence of a preference for Hb or of any difference in the visits of the males, for, while the males show 33.3 more in percentage of visits to B′ than the females do, they also show 15.1 more in percentage of visits to red. Local visits to red are 55.3 per cent, in the Berlin Garden 71.5, Low Germany 74.0 and the Alps 77.8. The visits of the males which fly late, do not differ from those of the females as much as the late visits of the females differ from the early ones. Visits to red show: females 51.5, males 66.6; females before July 71.4, after June 36.3.

Bombidæ.—Before July the Bombidæ prefer Ma and red; after June, Mas, red and yellow. They show less preference for B′ than does any other considerable group of long-tongued bees. The maxima shift from Hb 59.8 to B′ 42.0, Ma 50.8 to Mas 48.6. Visits to yellow change from 19.6 to 34.0.

Apygidial Scopulipedes.—These show every indication of great age: the fragmentary nature and the marked structural differences of the still existing groups, as well as their wide and discontinuous distribution. Müller says that the maxillary palps of *Bombus*, etc. are aborted as a result of specialization of the proboscis, lengthening of the glossa and labial palps (**4**,57). But it is evidently a mark of age, for many Pygidialia have the proboscis as long and even more highly specialized, but retain the primitive number of six joints. It seems that the Apygidialia were the primitive long-tongued bees and had most to do with the origin of the earliest long-tongued bee flowers. The specialized genera of Pygidialia are characterized by long tongues, rapid flight, rather short seasons, often oligolectic and more peculiar habits, just as would be expected of later developed competitors.

Anthophoridæ.—Of 75 visits to 56 flowers, 66.6 per cent are to Ma, 22.6 to Mas, 54.6 to red, 21.3 to Labiatæ, 16.0 to Leguminosæ and 10.6 each to Polemoniales and Personales.

Euceridæ (521 visits to 202 flowers).—These prefer Mas, which shows 31.6 per cent of the flowers visited and 54.7 per cent of the visits, red 39.9 and yellow 35.7, 10.5 per cent of the visits being to Labiatæ and 40.8 to Compositæ. Twenty prefer Mas, 11 Ma, 19 red, 11 yellow, two white. Before July they prefer Ma, Mas and red; after June, Mas, yellow and red. The group is a late one. The maxima shift from Hb 60.3 to B′ 51.8, Ma 48.4 to Mas 66.2, red 42.8 to yellow 41.0.

Emphoridæ.—Of 14 visits to 11 flowers, 57.1 per cent are to Ma, 35.7 to Mas, 57.1 to red, 42.8 to white, 28.5 to Polemoniales and 21.4 to Compositæ.

Anthophoroidea.—Of the 610 visits of the last three families, 50.3 per cent are to Mas, 42.′ to red, 32.4 to yellow, 11.6 to

Labiatæ and 35.7 to Compositæ. Before July they prefer Ma, Mas and red; after June, Mas, red and yellow. The maxima shift from Hb 68.9 to B′ 49.0, Ma 56.1 to Mas 64.4.

Xylocopidæ.—The single species, *Xylocopa virginica*, near its northern limit here, is rare and its visits few. It seems to prefer Mas and red.

Ceratinidæ.—Of 194 visits to 162 flowers, 33.5 per cent are to Mis, 27.8 to Mi, 21.1 to Mas, 47.4 to white and 24.7 to Compositæ. The visits of the males differ remarkably from those of. the females and under similar conditions. The females show Mi 22.4, Mas 30.4, Mis 23.2 and red 32.5. The males show Mi 42.8, Mas 3.0, Mis 40.8 and red 14.2. In their visits they resemble the Halictidæ and *Apis mellifera.* Before July they prefer Mis, Mi, Pol, and white; after June, Mas, Mis and red. The maxima shift from AB 28.4 to B′ 55.2, Mis 35.3 to Mas 52.2, white 50.7 to red 37.3.

Melectoidea (ex. Nomadidæ; 209 visits to 72 flowers).—These prefer Mas 67.9, Mis 25.8 and yellow 41.1. Fifteen prefer Mas, five Mis, one Ma, ten yellow, six red, six white. Of the visits of Epeolidæ 15.6 per cent are to Labiatæ and 58.5 to Compositæ.

Nomadidæ.—Of 272 visits to 108 flowers 48.5 per cent are to Mis, 31.9 to Mi, 51.1 to white, 36.3 to yellow, 14.7 to Compositæ, 14.3 to *Salix* and 11.7 to Rosaceæ. Being inquilines at least principally of Andrenidæ they are associated with them in time and place and naturally show similar flower visits. Sixteen prefer Mis, four Mi, two Mas, 14 white, nine yellow.

Melectoidea.—Of the 481 visits, 38.6 per cent are to Mis, 33.4 to Mas, 41.7 to white and 38.4 to yellow. The Nomadidæ make only 17 visits after June, and the other Melectoidea make only five visits before July, so that their differences are largely phenological. Before July they prefer Mis, Mi, yellow and white; after June, Mas, Mis and yellow. The maxima shift from AB 32.6 to B′ 58.9, Mis 45.7 to Mas 66.0, white 50.5 to yellow 39.6.

Megachilinæ.—The Megachilini (331 visits to 151 flowers) prefer Mas, Mis, red 40.1 and yellow 33.3. The flowers visited show Mas 33.1, Mis 26.4, while the visits show Mas 53.8, Mis 16.1. Visits to red in Low Germany are 67.0 per cent and the Berlin Garden 74.0.

Of 110 visits of *Cœlioxys* to 62 flowers, 54.5 per cent are to Mas, 28.1 to Mis and 36.3 to yellow. Loew (**2**,264) calls it an oligotrope of red colors, but it shows 30.0 under red compared with 60.0 in the Berlin Garden and 66.0 in Low Germany. Of visits to red the females show 42.2 and the males 28.9.

Nineteen species of Megachilinæ prefer Mas, three Ma, 11 red, nine yellow and two white. Of their visits 12.8 per cent are to Labiatæ, 17.5 to Leguminosæ and 39.5 to Compositæ. The maximum changes from Hb 50.3 before July to B′ 42.0 after June.

Osmiinæ.—Of 295 visits to 138 flowers, 27.7 per cent are to Ma, 27.4 to Mi, 48.1 to white, 15.2 to Leguminosæ, 11.1 to Rosaceæ and 10.3 to Polemoniales. Seven prefer Mi, 41.8 per cent of visits, 5 Ma 66.6, 5 Mas 41.3, 3 Mis 57.1, 13 white 52.6, 5 red 43.3, 2 yellow 66.6. Local visits to red are 27.4 per cent, Berlin Garden 65.0 and Low Germany 77.2. Visits to Mas show for the females 22.6, for the males 6.2. Before July the Osmiinæ prefer Ma, Mas, Mi, white and red; after June, Mas, Mis, white and yellow. The maxima shift from Hb 43.7 to B′ 48.9, Mi 32.8 to Mas 57.4.

Anthidiini.—Of 9 visits to 8 flowers, 88.8 per cent are to Mas, 44.4 to red and 33.3 to yellow. Visits to red in Low Germany are 72.7 and in the Berlin Garden 87.0.

Stelidini.—Of 17 visits to 16 flowers, 76.4 per cent are to Mis, 58.8 to white, 41.1 to yellow, 58.8 to Compositæ. In the Berlin Garden 41.6 per cent of the visits were to red.

Dasygastræ.—Of 812 visits made by the last four groups, 40.8 per cent are to Mas, 33.3 to red, 10.3 to Labiatæ, 15.6 to Leguminosæ and 30.7 to Compositæ. Of the visits of the nest-makers 18.2 per cent are to Mis, 34.1 to red and 61.9 to social flowers; while of the visits of the inquilines 34.6 per cent are to Mis, 35.6 to yellow and 90.4 to social flowers. Before July (Osmiinæ 256 visits, Megachilinæ 133) they prefer Mas and red; after June (Osmiinæ 47, Megachilinæ 389) Mas, yellow and red. The maxima shift from Hb 44.8 to B′ 43.4, Ma 27.2 to Mas 57.2, white 43.3 to red 36.4.

Müller (4,55) says: "More than nine-tenths of the flowers visited by bees with abdominal brushes are such as are adapted to dust the ventral surface of the bee with pollen (*Echium*, Papilionaceæ, Compositæ, etc.) without any action of the tarsal brushes. More rarely, bees with abdominal brushes may be seen feeding on flowers whose pollen gets applied to their backs; in such cases the bee makes use of its tarsal brushes to sweep off the pollen from the parts where it has fallen into the abdominal brushes." Considering the composition of the flora Müller's statement shows about what these bees would be expected to do without preference. Of 243 local flowers visited for pollen by long-tongued bees in general, only 11.1 per cent require the use of the tarsal brushes. Of 146 visited for pollen by the Dasygastræ, 5.2 per cent require the use of the tarsal brushes. It is not easy to separate such flowers, because the Dasygastræ often reverse on nototribe flowers so as to receive the pollen on their undersides, as in the case of *Linaria vulgaris*, *Pentstemon*, *Impatiens* and *Pinguicula*. They also reverse on some species of *Gerardia* and *Viola*, but these flowers compel them to turn head downwards. On tubular flowers with included anthers they collect the pollen which adheres to their tongues, *Lithospermum canescens*, *Verbena stricta*.

Compared with other groups the Dasygastræ show a marked predilection for sternotribe flowers, 47.5 per cent of thei pollen visits. They do not equal the Euceridæ in their prefererence for Compositæ or antipathy to nototribe flowers.

Müller (4,55) further says: "There can be little doubt therefore that the bees with abdominal brushes have adapted themselves to the flowers which were fitted to dust their ventral surfaces (Papilionaceæ, Compositæ, *Echium*, etc.), and the contrary view, that these flowers have become adapted to the bees, is untenable, for the flowers are visited and fertilized by other and far more numerous insects." The Dasygastræ and Papilionaceæ have July maxima. There are several sternotribe flowers of which these bees are the most important and almost exclusive visitors.

Panurgidæ.—Of 141 visits to 84 flowers, 44.6 per cent are to Mas, 31.9 to Mis, 50.3 to yellow and 60.2 to Compositæ.

Red shows 31.3 per cent of the flowers visited and 19.8 per cent of the visits. Yellow shows 33.7 per cent of the flowers. Nine prefer Mas, five Mis, two Mi, ten yellow, four white and two red. Before July they prefer Mas, Pol and red; after June, Mas, Mis and yellow. The maxima shift from Hb 35.7 to B′ 66.6, red 39.2 to yellow 55.8. The heterotropy is given in **7,** 172-3.

Halictidæ (ex. Sphecodini).—Of 1840 visits to 287 flowers, 41.8 per cent are to Mis, 28.5 to Mi, 51.3 to white, 33.4 to yellow and 21.6 to Compositæ. Mis shows 30.3 per cent of the flowers visited. Visits of females show Mi 30.8, Mas 13.4; of males, Mi 10.0, Mas 27.1. Visits to red are 15.2 per cent, Low Germany 35.6 and Berlin Garden 38.0.

Loew (**2**,71) calls Halictidæ males oligotropes of B′. The males begin to fly about June 4 and are limited mainly to flowers observed after June, when the Halictidæ in general make a smaller percentage of visits to B′ than any other short-tongued bees, except *Prosopis*. The percentage of visits to B′ after June is for the females 36.3, while that for the males is 39. The females make pollen visits to many deep tubed Compositæ on which the males do not occur.

Sphecodini.—Of 111 visits to 57 flowers, 54.9 per cent are to Mis, 33.3 to Pol, 63.9 to white, 35.1 to yellow, 27.9 to Umbelliferæ, 18.9 to Compositæ, and 10.8 to Labiatæ. Visits to red are 0.9 per cent, in Low Germany 26.7.

Halictidæ.—Of 1951 visits of the Halictidæ in general, 42.5 per cent are to Mis, 27.5 to Mi, 52.0 to white and 33.5 to yellow. Of 165 non-pollinating visits, 53.7 per cent are to Ma, 37.5 to Mas and 52.1 to red. Forty prefer Mis, six Pol, six Mi, three Mas, 38 white, 17 yellow and only one red. Before July they prefer Mis, Pol, Mi, yellow and white; after June, Mis, Pol and white. The maximum shifts from AB 37.2 to B′ 37.6.

Andrenidæ.—Of 585 visits to 133 flowers, 59.6 per cent are to Mis, 54.4 to white, 40.0 to yellow, 18.6 to Rosaceæ, 15.7 to *Salix*, 12.8 to Umbelliferæ and 11.4 to Compositæ. Mis shows 37.5 per cent of the flowers visited. Red shows 5.4 per cent of local visits, in Low Germany 26.0 and Berlin Garden 46.7. Thirty-seven prefer Mis, four Mas, four Ma, four Mi, 28 white, 19 yellow and four red. Before July they prefer Mis, Pol, white and yellow; after June, Mis, Mas and yellow. The maxima shift from AB 50.5 to B′ 86.2, Mis 60.7 to Mas 50.0, white 56.9 to yellow 56.8.

Prosopididæ.—Of 166 visits to 74 flowers, 61.4 per cent are to Mis, 24.7 to Pol, 68.6 to white, 34.9 to Umbelliferæ, 16.8 to Compositæ and 12.6 to Rosaceæ. Visits to red are 0.6 per cent, Berlin Garden 32.5, Low Germany 36.7. Eight prefer Mis, and one Mi. Before July they prefer Mis, Pol, white and yellow; after June, Mis, Pol and white. The maximum shifts from A 40.5 to B′ 31.2.

Colletidæ.—Of 140 visits to 89 flowers, 52.1 per cent are to Mis, 15.0 to Pol, 50.0 to white, 39.2 to yellow, 14.2 to Umbelliferæ and 37.1 to Compositæ. Seven prefer Mis, four Mi, three Mas, seven white, five yellow and three red. Under Mas the females show 22.0 per cent, while the males show only 8.6. Before July there is a maximum of 34.3 under B, after June it changes to 58.7 under B′.

Long-tongued Bees.—Of 3061 visits to 370 flowers, 37.7 per cent are to Mas, 22.1 to Mis, 34.0 to red, 31.4 to yellow, 10.5 to Leguminosæ and 30.3 to Compositæ. Of the flowers visited and visits Ma shows 32.4 and 23.6, while Mas shows 22.4 and 37.7. Visits to red in the Berlin Garden are 60.4, in the Alps 63.3. Seventy prefer Mas, 31 Ma, 11 Mi, 60 red, 43 white, 43 yellow. Before July they prefer Mas, Ma, Mis and red; after June, Mas, Mis, yellow and red. Visits after June show the preferences probably better than the general visits because the majority of long-tongued bees are late. The maxima shift from Hb 43.0 to B′ 46.9, Ma 31.5 to Mas 56.9, white 43.5 to red 37.8.

Of the visits of the polyleges 32.5 per cent are to Mas, 30.8 to Ma and 37.0 to red; of the inquilines 38.4 to Mas, 36.3 to Mis, 35.8 to yellow and 40.4 to white; of the oligoleges 68.2 to Mas, 45.5 to yellow and 36.2 to red. The polyleges show the highest percentages to Ma and red, the oligoleges to Mas and yellow, and the inquilines to Mis and white. The oligoleges show the highest percentage of visits to social flowers, 86.0, and the polyleges to non-social 43.9. Forty-two prefer non-social flowers. Non-pollinating visits (66) show for Ma 68.1, Mas 28.7

and red 56.0. The long-tongued bee visits show gains over the short-tongued of 19.6 for Ma, 23.8 for Mas and 22.1 for red.

Short-tongued Bees.—Of 3002 visits to 305 flowers, 46.7 per cent are to Mis, 24.4 to Mi, 10.8 to Pol, 52.1 to white, 35.8 to yellow, 10.8 to Umbelliferæ and 21.9 to Compositæ. Of the flowers visited Mis shows 29.1 per cent and Mi 32.1. Ninety-seven prefer Mis, 20 Mas, 18 Mi, 6 Pol, 4 Ma, 87 white, 53 yellow and ten red. Visits to red are 11.9 per cent, Berlin Garden 34.3, Alps 36.2. There is a preference for Mas after June. The maximum changes from AB 39.1 to B′ 44.1. Of the visits of the polyleges (*Prosopis* excluded) 44.6 per cent are to Mis, 27.9 to Mi, 9.3 to Pol, 52.8 to white, 33.3 to yellow; of the oligoleges 49.7 to Mis, 31.7 to Mas, 7.1 to Pol, 55.3 to yellow; of the inquilines 58.7 to Mis, 29.3 to Pol, 62.7 to white and 36.5 to yellow. Their preference for Mi connects the short-tongued bees pretty definitely with the origin of these most primitive entomophilous flowers.

The short-tongued bees, compared with the long-tongued, show preferences for Mi 12.4, Mis 24.6, Pol 6.4, white 17.6 and yellow 4.4. Non-pollinating visits (192) show under Ma 56.7, Mas 38.5 and red 53.6.

Bees, Total (6063 visits to 417 flowers).—Of bee visits 34.2 per cent are to Mis, 25.7 to Mas, 43.2 to white and 33.5 to yellow, 127 preferring Mis, 93 Mas, 35 Ma, 29 Mi, 6 Pol, 130 white, 96 yellow and 70 red. Visits to red are 23.1 per cent, Berlin Garden 55.4 and the Alps 57.1. As might be expected, bee visits coincide more nearly with the observed flora than the visits of any other group of anthophilous insects.

Before July the bees prefer Mis, after June they prefer Mas. The change in the maximum from Mis 38.1 to Mas 45.2 results from the combination of the short-tongued bees which predominate early with the long-tongued bees which predominate late. The maximum shifts from AB 29.9 to B′ 45.7.

The polyleges (*Prosopis* excluded) make 73.3 per cent of the total bee visits. They show the highest percentages of visits to Ma 16.9, Mi 21.0, red 24.6 and white 44.6, the oligoleges to Mas 50.0 and yellow 50.4, and the inquilines to Mis 39.9 and Pol 8.5.

Of the visits of bees 13.9 per cent are to Ma and these are 81.6 per cent of the total visits to that class. Bees show the highest percentages of visits to flowers of all classes, except Pol, and to all colors, Ma 81.6, Mi 59.7, Mas 54.7, Mis 37.3, red 59.7, white 36.6, yellow 45.9. They are 22.9 per cent of the insects observed and make 43.3 per cent of the visits.

According to the general visits the long-tongued bees show a preference for Mas 19.0, for Mis 0.6. In the case of 61 flowers on which the individuals were taken as they came, they showed a gain over visits for Ma 8.9 and Mas 15.4. The short-tongued bee visits show a preference for Mis 25.2, Pol 5.6 and Mi 0.2. The individuals show a gain over visits for Mis, 33.1. So the characteristic differences between long-tongued and short-tongued bees are better indicated by counting the individuals than by counting the visits.

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A NEW GENUS OF MAYFLIES FROM THE MIOCENE OF FLORISSANT, COLORADO.

By T. D. A. Cockerell.

University of Colorado, Boulder, Colo.

Among some fossil insects from Florissant kindly loaned by Director J. D. Figgins of the Colorado Museum of Natural History, I find a very fine Ephemerid belonging to the Siphlonuridæ* and apparently referable to an undescribed genus. Banks, in 1907, treated *Chirotonetes* and *Ameletus* of Eaton as synonyms of *Siphlonurus*. On this broad basis the fossil might also be referred to *Siphlonurus*; but more recent authors have recognized Eaton's segregates, and from this point of view *Siphlurites* forms a sufficiently valid genus. In the description, I have followed Tillyard's revised nomenclature†, but it should be understood that Tillyard's first and second cubitus are Comstock's first and second anals (following Miss Morgan); Tillyard's media is Comstock's cubitus, and Comstock's media is considered part of the radius. In Needham's key to the genera‡, *Siphlurites* runs out on p. 25 at ff, forming a third section as follows:

fff. The intercalaries between the first and second anal veins (of Needham and Comstock) represented by a pair of veins, the first simple, the second forking, from the first anal to the wing margin, and a third vein which bends and runs a long course parallel with the first anal, emitting below about nine simple veins to the margin .... *Siphlurites*.

Siphlurites new genus.

Anterior wings with costæ somewhat arched basally, the costal area broadened; so that its depth is 1 mm., gradually decreasing apicad; transverse veins of costal area numerous

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*Tillyard writes Siphluridae, but Eaton named the type genus *Siphlonurus* in 1868, and was not at liberty to alter it to *Siphlurus* in 1871.

†Transactions New Zealand Institute 54. (1923) p. 227.

‡Bull. 86, New York State Museum (1905) pp. 23-26.

in subbasal region, forming cells which are twice as high as long, but beyond they become widely spaced, forming cells which are much longer than high; subcosta in subbasal region very close to radius, gradually diverging from it, so that near middle of wing the subcosta is equally distant from costa and radius; radial sector with four very oblique branches, the first forking a little over 6 mm. from end, and including within the forks a supplementary longitudinal vein; the second and third branches of the radial sector originate close together, but the origin of the third, though delicate, is not obsolete; the fourth, arising about 7.6 mm. from end of wing, starts downward at nearly a right angle with the sector, and then bends distad; between it and the sector are three supplementary veins, the first long, the two lower shorter; media branching about 3.7 mm. from base of wing, the fork very acute, and between the branches a long supplementary vein, and near the margin four short very delicate supplementary veins, two above and two below the main supplement; cubitus with main (upper) part strong, slightly curved subapically, emitting about five cross veins to the strongly arched second cubitus, then two long veins (the second forked) to margin, then, beyond level of end of second cubitus, a vein which curves distad travelling to the margin parallel with the first cubitus, and emitting about nine oblique veins below. Hind wings developed, but the details cannot be made out. Type the following.

Siphlurites explanatus, sp. nov.

Length from front of head to end of abdomen 21 mm.; expanse 44 mm.; length of anterior wings 21 mm., the width about middle 7.7 mm.; eyes to base of wings 1.7 mm., the prothoracic region short and broad (it is considerably longer in *Ephemera howarthi*.) Head and thorax brown; wings hyaline, with pale brown veins; a slight suggestion of mottling along costa

Miocene shales of Florissant.

Scudder described five species of Ephemerid nymphs from Florissant; so far as can be seen, they suggest the genera *Ephe-*

merella, *Hexagenia*, *Potamanthus* and *Baetis*. Two species have been described from adults. *Ephemera exsucca* Scudd. has an expanse of only 16 mm.; *E. howarthi* Ckll has three strong tails, as in true *Ephemera*. In the somewhat arched costa and broad costal area *Siphlurites* agrees with *Cronicus anomalus* (Pictet) from Baltic amber, but is is otherwise quite different.

It is worthy of note that in the Permian *Protereisma* and *Protechma* of Sellards the first cubitus emits a couple of veins at very acute angles (not curved at base as the long branch of *Siphlurites*), and these proceed distad to the margin, subparallel with the first cubitus. Thus the special feature of *Siphlurites* may be regarded as primitive. The Permian insects constitute a distinct family Protereismatidæ, having the lower wings almost or quite as large as the upper.

UTAH VARIETIES OF A ROSE ROOT GALL WASP (HYMENOPTERA)[1]

BY ALLAN R. HUBTER.

Diplolepis radicum var. **utahensis** (Bassett)

Rhodites Utahensis Bassett, 1890, Trans. Amer. Ent. Soc., XVII, p. 62.

Diplolepis radicum utahensis Kinsey, 1922 (in part), Ind. Univ. Studies, 53, p. 68.

Female.—Differs from the female of variety *angustior* in the following characters; Parapsidal grooves more gradually convergent toward and more separated at the scutellum; median groove distinctly but discontinuously indicated for one half the mesonotal length; anterior parallel lines not as distinct toward the pronotum; the smooth area on the scutellum is larger, more rugose, and connected to the mesonotum by a much wider isthmus; the transverse, rugose band across the mesopleura is considerably wider and less distinct in outline; the rufous area on the abdomen, dorso-basally, is larger and lighter; the areolet is a little smaller.

Male.—Differs from the male of variety *angustior* only in varietal characters as described for the female.

Gall.—Practically the same as the gall of *angustior*.

Range.—Utah: Thistle (Weld), Price (Kinsey). Probably occurs throughout the Colorado Plateau country of parts of Utah, Colorado, New Mexico, and Arizona.

Types.—Lost.

Diplolepis radicum var. **angustior** var. nov.

Diplolepis radicum utahensis Kinsey, 1922 (in part), Ind. Univ. Studies, 53, p. 68.

Female.—Differs from *utahensis* in the following characters: Parapsidal grooves make an abrupt curve in, and converge more closely at the scutellum; median groove is variable, from a mere indication at the scutellum to discontinuous indications for one-third of the mesonotal length, and is less distinct; anterior parallel lines more distinct toward the pronotum; the smooth area on the scutellum is smaller, more distinct in outline, not so rugose, and connected to the mesonotum by a narrower isthmus; the transverse, rugose band across the mesopleura is considerably narrower and more distinct in outline; the rufous area on the abdomen, dorso-basally, is smaller and darker; the areolet is a little larger.

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[1] Contribution from the Zoological Laboratories of Indiana University No. 195 (Entomological No. 4).

Male.—Differs from the male of variety *utahensis* only in varietal characters as described for the female.

Gall.—Practically the same as the gall of *utahensis.*

Range.—Utah: Provo, Brigham (Kinsey). Probably confined to more northern Utah and adjacent Idaho.

Types.—A great many females, about forty galls. Holotype female, paratype females, males, and galls at The American Museum of Natural History; paratype adults and galls at the Museum of Comparative Zoology, the U. S. National Museum, the Philadelphia Academy, Stanford University, the California Academy, and the Kinsey collection. Labelled Provo, Utah; April 18, 1920; Kinsey collector.

The variety *utahensis* is found at Price, Utah, while variety *angustior* is found at Provo; the two localities are separated by only sixty miles, but Price is a thousand feet higher in elevation. The two varieties are so closely related that they have heretofore been considered the same; the relationship is so close that they are hardly separable on any one character, but they are easily distinguished by a combination of characters. The most distinctive characters are the transverse rugose band on the mesopleura, the size of the areolet, and the smooth area and isthmus on the scutellum.

It is interesting to note that all other Cynipidæ known from Utah have two very closely related varieties in a more northern and more southern faunal area; *utahenesis* has been the only exception, but now that *angustior* has been described, the rule holds without exception. *Plana*, another variety of the same species from southeastern Oregon, is almost as closely related to *utahensis* and *angustior*.

Dr. Kinsey of the Zoology Department of Indiana University has supervised this study.

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